McGill

Department of Mechanical Engineering

MECH 573: Mechanics of Robotic Systems
Winter 2006: TR 11:35-12:55 ENGTR 1090
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Assignment No. 4 Due date: 2006/02/16

1) For the Five-bar, 4R1P manipulator introduced in assignment No. 3 whose schematic diagram are given in figure 1, derive the Jacobian matrices J_x and J_q, and discuss on the inverse and direct kinematics singularities.
Note that the end effector position is denoted by vector $\boldsymbol{x}=[q_x, q_y]^T$ and joint variable vector is defined as $\boldsymbol{q}=[d_1, \theta_2]^T$. The Jacobian matrices to be found are defined as $J_x\dot{x} = J_q\dot{q}$.

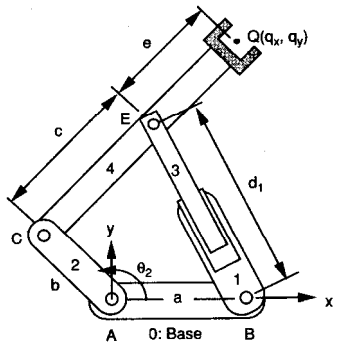

Figure 1. Five-bar, 4R1P manipulator.

2) For the 3UPU platform manipulator illustrated in Figure (2) find the Jacobian matrices J_x and J_q, and discuss on the inverse and direct kinematics singularities. For this manipulator the end effector position is denoted by vector $\boldsymbol{x}=[p_x, p_y, p_z]^T$ and joint variable vector is defined as $\boldsymbol{q}=[d_1, d_2, d_3]^T$

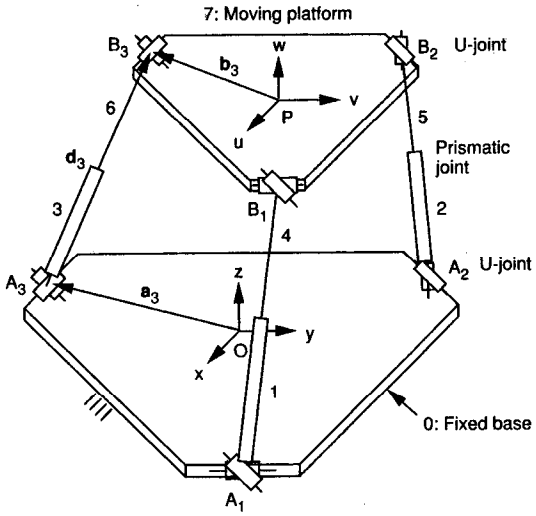

Figure 2. The schematics of a 3 DOF 3U3P parallel manipulator.

3) Derive the conventional Jacobian matrices of the 3x3 Stewart Gough Platform shown in figure (3) by the velocity vector loop method. Does this manipulator possess any inverse kinematics singularities?

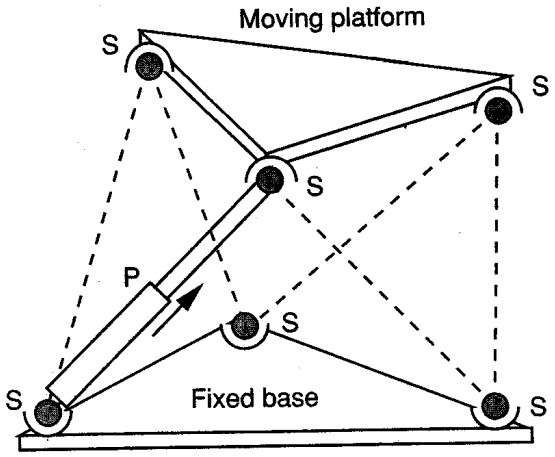

Figure 3. The schematics of a 3x3 Stewart Gough Platform.

4) Formulate the Jacobian matrices of the 3x3 Stewart Gough Platform shown in figure (3) by the method of reciprocal screws.

"Good Luck"